In all the above cases inertia has been ignored. If, however, an axle moves at high speed and it attempts to follow a sinusoidal path, inward accelerating forces proportional to the square of the velocity must act at the wheel treads. These forces involve outward creep with the result that the amplitude of the oscillations tends to build up. Without damping, a small disturbance will increase in amplitude until one or both wheel flanges strike the rail. The equations of this motion are given in the following two papers which also suggest methods of improving the riding of coaching stock.

Dial House, Great Shelford, Cambridge R. B. M. JENKINS

REFERENCES

R. D. Davies " Some Experiments on the Lateral Oscillation of Railway Vehicles ", *Journal of the Institute of Civil Engineers*, March 1939.

R. M. Hancock " Vehicle Suspension and Bogie Design ", *Journal of the Institute of Locomotive Engineers*, Vol. 49 (Part 4) 1959–60.

CORRESPONDENCE

To the Editor of the *Mathematical Gazette*

DEAR SIR,—Readers of the Gazette may be interested to know the results of the Annual Contest sponsored by the Mathematical Association of America which took place in March this year, and in which several British schools participated, 200 boys of ages 14–18 being involved.

Approx. 170,000 competitors entered in the U.S.A.; the upper and lower quartiles, and median, respectively for the " best individual score per school " were 53, 26, 38. Two boys attained a perfect score of 150. The best individual score in this country was 118½ (a Maths specialist currently taking A level); one boy aged 15 : 11 scored 96. The average score for our competitors over 17 (i.e. roughly A level) was approx. 50, and for the range 14–16 (i.e. roughly O level) was about 30.

Comparisons of any kind are difficult because of differences of age and background; however the test gave a rough idea of what could be expected at different ages, while comparisons *within one form* at a School were possible and interesting. It seemed to be generally true that the very good boy did well. Other details of the Contest may be found in a previous letter [Gazette No. 353, p. 251] and in the Contest Problem Book by C. T. Salkind [reviewed in Gazette No. 356, p. 156]. The Contest will take place again in March of next year. I can give further information on entry etc. to interested schools.

Yours faithfully, F. R. WATSON

Manchester Grammar School.

Examples of questions taken from the 1962 Paper:

18. A regular dodecagon is inscribed in a circle with radius r inches. The area of the dodecagon, in square inches, is:

$A.\ 3r^2$ $B.\ 2r^2$ $C.\ 3r^2\sqrt{\frac{3}{4}}$ $D.\ r^2\sqrt{3}$ $E.\ 3r^2\sqrt{3}$

22. The number 121_b written in the integral base, b, is the square of an integer for:

$A.\ b=10$ only $B.\ b=10$ and $b=5$ only $C.\ 2\leqslant b\leqslant 10$
$D.\ b>2$ $E.$ no value of b.

23. In $\triangle ABC$, CD is the altitude to AB, and AE the altitude to BC. If the lengths of AB, CD, and AE are known, the length of DB is:
$A.$ not determined by the information given $B.$ determined only if A is acute $C.$ determined only if B is acute $D.$ determined only if ABC is an acute $\triangle$ $E.$ none of these is correct.

40. The limiting sum of the infinite series $1|10+2|10^2+3|10^3+\ \ldots$ whose nth term is $n|10^n$, is:

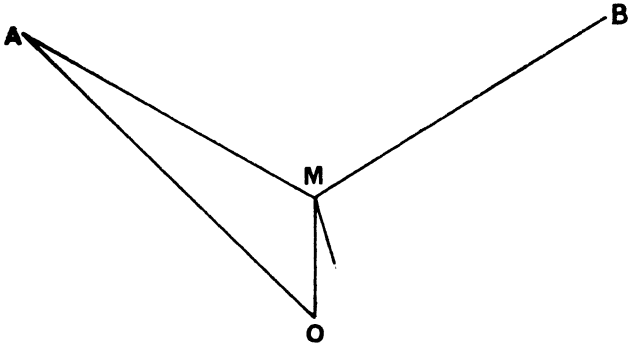
$A.\ \frac{1}{9}$ $B.\ \frac{10}{81}$ $C.\ \frac{1}{8}$ $D.\ \frac{17}{72}$ $E.$ larger than any finite quantity.

The Editor, The *Mathematical Gazette*.

DEAR SIR,— Following a reference by Mr A. P. Rollett, during a recent lecture, to the minimum length of road required to connect the four corners of a square, I have tried to reduce the problem to a simple form. Take a piece of wood, 3 tin-tacks, and a piece of string, and tie one end of the string to corner B. Carry the string around corner A, and centre O, and up and around the mid-point of string AB. Pull down, and the maximum length of the loose end will indicate the minimum lay-out of the road system i.e. AM plus MB plus OM, together with a similar figure in the lower half of the square. If a pencil were attached to the loose end, and the eye of a needle employed to keep the junction in position, the relevant graph could be drawn, and would support the result, readily obtainable by using the calculus, that $\angle AMB=120°$

Yours faithfully, R. C. THOMAS

Aish House,
Stoke Gabriel,
Devon.



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